

PARENT-CHILD MATHEMATICS: A STUDY OF MOTHERS' CHOICES

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Research on mathematics found in 'everyday' interactions (e.g., Walkerdine, 1988) often relies on analysis of parent-child talk during studies of social interactions and/or literacy events more generally. In contrast, from the outset of the current study, parents were aware that mathematics was the focus of study and that each of them would determine the activities to be video-taped in their home. In this paper, we report on the types of activities six middle class mothers perceived as opportunities to engage their preschool child with mathematics. Analysis also included the patterns found within and across families. Overall, the mothers documented play-based events, many of which were common across four or more homes and entailed 'less conventional' mathematics. Parental styles of mathematical engagement are discussed.

BACKGROUND

Gifford (2004) argued that the formal and informal pedagogy that supports children's development of early mathematical competence has not been well documented. While we know children enter school with considerable mathematical knowledge, we know much less about the ways in which parents and significant other family members support them in developing that knowledge prior to school. Much of the recent research, into young children's mathematics learning within the context of home and family relies on parent reports (e.g., Lefevre et. al. 2009) or observations of parent-child interactions during activities or tasks, using materials provided by the researchers (e.g., Vandermaas-Peeler, Nelson, Bumpass & Sassine, 2009; Anderson, Anderson & Shapiro, 2005; Anderson, 1997). This research on young children's engagement in mathematical activities at home demonstrates considerable diversity across families in terms of the frequency and types of math, although findings across studies indicate that families tend to emphasize counting and number concepts (e.g., Anderson, Anderson & Thauberger, 2008). Of particular relevance to the current study are the few studies (Walkerdine, 1988; Aubrey, Bottle & Godfrey, 2003; Trudge & Doucet, 2004), which investigated parent-child interactions during 'naturally occurring' events at home through audio or video recording or direct observations. In these studies, although researchers identify the mathematics evident in activities and events or in parent-child interactions, it is unclear whether the parents construed the activities as mathematical. In contrast, in the present study, we were interested in having parents identify the activities that they believed were examples of ways in which they engaged their young children in mathematics. Thus this study investigated the types of activities parents view as contexts for mathematics learning, and the ways in which the activities evolved when parents knew the focus of the study was on

parent-child mathematical activities and events and the interactions that occurred therein. We documented parents' self-selected mathematical activities in the context of their home, providing insight into the nature of activities that mothers perceive as opportunities to engage their preschool child with mathematics. By asking participants to identify and document mathematical activities and events in the home, the current study augments previous studies, which rely on parent reports alone. Likewise, unlike studies where researchers provide the materials and tasks for the parents and children, the current study observed the ways in which the parent-child dyads constructed activities using resources found in their homes.

Our research is informed by socio-historical theory (e.g. Vygotsky, 1978; Wertsch, 1998) and the notion that learning is social, as well as individual. Children learn to use the "cultural tools" such as mathematics of their community and culture inter-psychologically as they are guided and supported by parents and significant other people. As they practice using these "tools" and support is gradually withdrawn, children learn to use them intra-psychologically or independently.

METHOD

Six families were recruited from an unaffiliated Child Study Centre located on a university campus. The children (5 girls, 1 boy) were two and a half years old at the beginning of the study. The parents were well-educated, middle to upper-middle class, and lived in relatively affluent neighbourhoods adjacent to the university campus. On mutually convenient occasions spread over two years, we videotaped parent-child dyads (4 mother-daughter, 1 father-daughter, 1 mother-son) participating in everyday 'at home' events of their choosing (e.g., baking cookies, viewing photos). As indicated earlier, we informed parents at the outset that the research focus was on children's early mathematics in the home. At the beginning of each home visit, the mother designated the shared activity that was to be videotaped. Four of the families were video taped by the same research assistant, who remained the field researcher for the duration of the study. Two of the mothers opted to carry out their own videotaping, an option made available to all parents. The number of video taped sessions varied across the families (i.e. 4-10), with all sessions lasting at least 15 minutes.

To analyse the data, we viewed the videotapes of each family three times, and wrote comprehensive notes during each viewing. We then transcribed each videotaped session for each family in its entirety. The first author read the transcripts three times, referring to the initial notes each time so as to provide thorough documentation and understanding of each episode. Each transcription was then analysed in terms of the types of activities and events in which each family engaged. Patterns across and within families and similarities and differences across activities and events were determined. Secondly, parent-child interactions were analysed according to the extent to which mathematics was explicitly present in the interactions as the activity evolved. For that analysis, we used five a five point scale, namely mathematics was deemed: (a)

prevalent b) a major focus c) an equal focus with other aspects d) a minor focus or e) incidental throughout the activity, from an observers' perspective.

RESULTS

Because each mother individually identified the activities and events to videotape without consulting any other participants, diversity across families was anticipated. Overall, 44 specific activities (e.g., playing Snakes & Ladders; viewing Photos) were documented. When these were clustered according to general defining features (e.g., board games; family time), thirteen categories emerged (see Table 1). Eleven of the 13 categories contained activities chosen by at least half of the mothers. The most common categories were puzzles, pretend play, board games, story time, family time and playing with toys. Closer examination revealed that the activities chosen were mainly those we intuitively associate with children's play (i.e., using stickers to create pictures) and child's at-home participation in family routines (i.e., baking cookies) with minimal examples of school-like activities. Indeed, these mothers predominately chose to videotape adult-child play of one sort or another.

As might be expected from the design of the study, each videotaped activity within the categories was unique to the parent, child and materials involved. For instance, the 'number' puzzles that the Adam (pseudonyms are used throughout) family used incorporated puzzle pieces with a numeral fitting onto a background space showing the same number of objects. On the other hand, the jigsaw puzzles that the Pimm family used involved a picture broken into a number of irregular, interlocking pieces. Such contrasts led us to consider to what extent the mothers' choices were based on overt mathematical features of some materials marketed to homes. We labelled an activity 'conventional', when numerals, shapes and counting were key features of the material (e.g., BINGO) and 'less conventional' when mathematical elements or features were not deemed key to the typical use of the material (e.g., Hungry Hippos). Analysis revealed that about one-quarter of the activities (11), which the mothers chose to videotape, involved commercially produced mathematical materials, while over half of the activities (27), were characterized as less conventional, mathematically.

Finally, to describe the extent to which mathematics was explicit during the chosen activities, we used a 5-point scale described earlier (See Table 2). For example, as the Beet dyad played checkers, the mother often explained her moves and what might happen if the child moved one way or another. After a checkmate, the mother counted the checkers, and on one occasion the child made (and named) a square with four checkers. Here, counting and shape recognition were deemed explicit attempts to include mathematics, whereas the mother's explanations appeared to illustrate "how to" play the game. Thus we assigned "(d) Math occupies a minor portion of the activity but seems conscious" to best describe the minor role explicit mathematics seemed to play here. (See Table 2, Beet, board game.)

Category	Each family's activity					
	Adam	Star	Penn	Pimm	Liu	Beet
Puzzles	Number		Jigsaw(2)	Jigsaw	Number	Jigsaw
Play	Store	Stickers		Pegboard	Traintrac ks	Tea party
Board game	Snakes & Ladders	Hungry Hippos	BINGO			Checkers
Story time	Number & shapes	Felt story board		Sounds of World		Matching objects
Family time		Lunch		Photos	Videos	Baking
Toys		Traintracks	Cars	Food/dolls	Pop up	
Playdoh	Sharing pizza	Happy face				Making food
Physical games	Hopscotch			Follow the leader		Water sprinkler
Matching games	Cards: word numeral, dots			Cards: images	Rods: "Ten" family	
School like	Word problems			Yearbook entry	Compu- ter game	
Songs	1,2,buckle my shoe	Row, row your boat			ABCs	
Other games				Dreydel	Macaroni	
Miscellaneous				Penny tracing		

Table 1: Activities mothers chose to videotape

Activity	Adam	Liu	Penn	Star	Beet	Pimm
Puzzle	a	a	c		e	c
Play	a	b		a	d	d
Board game	a		a	b	d	
Story time	a			e	d	e
Familytime		b		d	a	e
Toys		b	b	e		e
Playdoh	a			d	d	
Physical	a				e	e
Matching	a	a				e
School	a	a				d
Songs	a	e		e		
Other games		a				e
Misc						e

a: Math is the core and goal of the activity.

b: Math occupies a major portion of the activity but was not the original goal

c: Math occupies an equal part of the event, other aims and content are achieved.

d: Math occupies a minor portion of the activity but seems conscious.

e: Math is incidental or subtle for the most part and may/may not be apparent

Table 2: Activities ranked on a continuum of mathematical involvement

Once each activity/family was coded, the analysis revealed that while one mother (Adam), chose the same type of activity each time, the other mothers chose activities, which varied somewhat according to the explicitness of the mathematics. In addition, we were surprised to see that the families' profiles appeared to fall along a similar continuum (See Table 2). That is, these mothers' choices suggested parental styles of engagement whereby for two families (Adam, Liu) the majority of the activities videotaped were explicitly mathematical, for two other families (Pimm, Beet) the majority of activities videotaped were incidentally mathematical and for the remaining two families (Penn, Starr) an eclectic style of engagement was evident.

DISCUSSION

Due to the small size and the homogenous nature of the sample, some caution is called for interpreting the findings of this study. However, we believe the findings from the study are significant and contribute to the literature on young children's engagement in mathematics at home. In previous research using self-reports and surveys (e.g., Lefevre et. al.), families have reported similar activities as these mothers chose to videotape (e.g. baking cookies; playing board games). Thus the current study provides further evidence of the "myriad of ways in which everyday practices common to many home environments" (Benigno & Ellis, 2008, p. 298) may support children's mathematics development. However, although many of the families in the current study engaged in playing board games for example, analysis revealed that families played an array of board games with different affordances in terms of mathematical learning. Thus the present study provides a more nuanced insight and understanding of these 'taken-for-granted' activities (i.e. 'doing puzzles'), as a site for children's early mathematics learning.

That the mothers chose mainly play based activities appears to reaffirm that "[m]uch of young children's exposure to math does not occur during explicitly didactic interactions" (Benigno & Ellis, 2008, p. 294). Likewise, it seems the mothers in the current study concur with the majority (77%) of parents interviewed by Canon and Ginsburg (2008) who believed "children's mathematical learning should be incorporated into their daily living" (p. 250). However, further research with families from diverse backgrounds is needed to determine the extent to which this holds for those outside the mainly Euro-Canadian, middle class homes represented here, especially since some cultural groups favour a more didactic form of teaching and learning with an emphasis on rote memory.

Unlike the somewhat dichotomous "instrumental or pedagogical typifications" put forth by Walkerdine (1988) and Aubrey et al. (2003) for mother-child mathematical interactions, in the current study, at home mathematical activity appeared to fit along a continuum as identified by the 5-point scale. Thus in addition to those activities at the extremes where mathematics was core or mathematics was incidental, we documented activities where mathematics played a major or minor role as well as those where mathematics seemed equally important to non-mathematical goals or aspects of the

activities. Looking across the six families, the results of this study suggest that in addition to mothers who take on a “pedagogic stance”, and others who share more instrumental activity with their child, some mothers adopt a more eclectic style of mathematical engagement than a dichotomous view permits us to see. Of course, it remains to be seen if preferences seen in the video taped sessions reported here, will prevail in other data sources (parent interviews, diaries) yet to be analysed or if an eclecticism within all families might be revealed as more of the families’ everyday practice is examined. While we concede that a continuum of parental practice complicates our search for a definitive explanation as to how and why children enter school with a range of mathematical knowledge, it likely better represents the complexity of the ways in which parents and children engage in mathematics at home. Further research, which accounts for the breadth and depth of mathematical experiences in families, is needed to better understand the nature of children’s mathematics learning prior to school.

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